Information about the exam in the course "Stochastic simulation"

The exam is oral and lasts for 20 minutes. The exact dates within the period January 31 – February 18 are decided by the administration. Typical possible questions are

- Chapter 1: What kind of problems can be solved by stochastic simulation, what are the basic ideas of stochastic simulation ? You should be able to explain 1 or 2 examples of your choice from this chapter.
- Chapter 2: How are uniform random numbers generated on a computer, what is a linear congruential generator, why is it periodic, when is the period maximal (you should now the conditions for $c \neq 0$ and that for $c = 0$ M has to be prime), why is a maximal period not sufficient for a good generator, what structure do the d-tupels have and how can we express this mathematically ?
- Chapter 3: Which methods to generate non-uniform random numbers do you know, which ones need the normalizing constant and which ones don't, which method would you choose for a concrete example of a density that I give you, why is the accept-reject method correct, what is the expected number of rejections in this method, what are the common features and the differences between importance sampling and accept-reject, how precise is a Monte Carlo estimate based on n replicates, what methods are available to improve this precision, can you give examples where these methods are used ?
- Chapter 4: Why do we need Markov chain Monte Carlo, what is the basic idea, what problems do we have to solve in order to use it, what is a stationary or a reversible distribution for a Markov transition, how can we construct for a given π P such that $\pi P = \pi$ (you should be able to discuss at least the discrete case), how can we choose a proposal distribution in the Metropolis-Hastings algorithm, how does the Gibbs sampler relate to Metropolis-Hastings ?

This list is not exhaustive. You should be able not only to give a brief answer to questions, but rather to explain what is behind a definition, how a results connects to other things, what the implications for the practical use are. There is no need to memorize complicated formulae, but you should be able to do simple computations which need only an understanding of the definitions and basic rules of probability. Students of mathematics should be able to do slightly more difficult computations than the others. The material in sections 4.2.2, 4.2.3 and the whole of 4.3 is not part of the exam.

If you have questions, you can ask them on January 17 and 24 2011 from 1 to 3 pm. The room (in the main building) will be announced on my web page. If you find mistakes or things that make no sense at all to you in the script, please let me know by email any time.

H. R. Künsch, December 16, 2010